

**What Is Claimed Is:**

1           1.       A method for verifying whether a trace can be produced by a  
2 generator, comprising:  
3           receiving a specification for the generator, wherein the generator is a finite  
4 state machine that defines a set of inputs and outputs, and wherein the generator may  
5 contain parametric inputs to model non-determinism;  
6           receiving the trace, wherein the trace is a sequence of assignments of non-  
7 parametric inputs and outputs for the generator, and wherein the trace does not  
8 contain assignments of parametric inputs;  
9           using the specification to build a data structure that can be used to determine  
10 if a non-parametric input and output are consistent with the current state of the  
11 generator; and  
12           verifying elements of the trace, wherein verifying a given element involves  
13 using the data structure to determine if there exists any parametric input assignment  
14 that causes a match between non-parametric inputs and outputs of the generator with  
15 the ones specified in the given element of the trace.

1           2.       The method of claim 1,  
2           wherein the generator is sequentially deterministic, which means that there  
3 exists a single next state for each combination of current state, non-parametric input,  
4 and output; and  
5           wherein using the data structure to determine if there exists any parametric  
6 input assignment involves,  
7                        using the data structure to perform a satisfiability test to  
8                        determine if there exist any parametric inputs that can match the non-

9 parametric input and output assignment of the generator with the ones  
10 of the trace at a current state, and  
11 computing a unique next state based on the current state, the  
12 non-parametric input and the output.

1 3. The method of claim 1,  
2 wherein the generator is sequentially non-deterministic, which means that the  
3 next state can depend on a parametric input, and consequently there can exist more  
4 than one next state for some combinations of current state, non-parametric input, and  
5 output; and  
6 wherein using the data structure to determine if there exists any parametric  
7 input assignment involves determining a set of next states;  
8 wherein determining the set of next states involves considering all possible  
9 parametric inputs, all states in a current set of states, the non-parametric input and the  
10 output;  
11 wherein if there exists at least one state in the set of next states, the non-  
12 parametric input and output are consistent with the generator.

1 4. The method of claim 3, wherein determining the set of next states  
2 involves computing a forward image and constraining the parametric input and  
3 output to their assignments in the trace.

1 5. The method of claim 1, wherein the trace is produced by a simulation  
2 of a system under test.

1           6.       The method of claim 1, wherein the data structure is in the form of a  
2   binary decision diagram (BDD).

1           7.       The method of claim 1, wherein if for all possible parametric inputs  
2   the non-parametric input and output are not consistent with a generator output, the  
3   trace is not valid.

1           8.       The method of claim 1, wherein if the specification of the generator is  
2   sequentially deterministic, and hence does not depend on parametric inputs, the  
3   method further comprises translating the generator into a checker and using that  
4   checker to verify the trace.

1           9.       A computer-readable storage medium storing instructions that when  
2   executed by a computer cause the computer to perform method for verifying whether  
3   a trace can be produced by a generator, comprising:

4           receiving a specification for the generator, wherein the generator is a finite  
5   state machine that defines a set of inputs and outputs, and wherein the generator may  
6   contain parametric inputs to model non-determinism;

7           receiving the trace, wherein the trace is a sequence of assignments of non-  
8   parametric inputs and outputs for the generator, and wherein the trace does not  
9   contain assignments of parametric inputs;

10          using the specification to build a data structure that can be used to determine  
11   if a non-parametric input and output are consistent with a parametric input and output  
12   for the generator; and

13          verifying elements of the trace, wherein verifying a given element involves  
14   using the data structure to determine if there exists any parametric input assignment

15 that causes a match between non-parametric inputs and outputs of the generator with  
16 the ones specified in the given element of the trace.

1       10.    The computer-readable storage medium of claim 9,  
2            wherein the generator is sequentially deterministic, which means that there  
3            exists a single next state for each combination of current state, non-parametric input,  
4            and output; and  
5            wherein using the data structure to determine if there exists any parametric  
6            input assignment involves,  
7                    using the data structure to perform a satisfiability test to  
8                    determine if there exist any parametric inputs that can match the non-  
9                    parametric input and output assignment of the generator with the ones  
10                  of the trace at a current state, and  
11                  computing a unique next state based on the current state, the  
12                  non-parametric input and the output.

1       11.    The computer-readable storage medium of claim 9,  
2            wherein the generator is sequentially non-deterministic, which means that the  
3            next state can depend on a parametric input, and consequently there can exist more  
4            than one next state for some combinations of current state, non-parametric input, and  
5            output; and  
6            wherein using the data structure to determine if there exists any parametric  
7            input assignment involves determining a set of next states of a generator;  
8            wherein determining the set of next states involves considering all possible  
9            parametric inputs, all states in a current set of states, the non-parametric input and the  
10           output;

11            wherein if there exists at least one state in the set of next states, the non-  
12 parametric input and output are consistent with the generator.

1            12.    The computer-readable storage medium of claim 11, wherein  
2 determining the set of next states involves computing a forward image and  
3 constraining the parametric input and output to their assignments in the trace.

1            13.    The computer-readable storage medium of claim 9, wherein the  
2 trace is produced by a simulation of a system under test.

1            14.    The computer-readable storage medium of claim 9, wherein the data  
2 structure is in the form of a binary decision diagram (BDD).

1            15.    The computer-readable storage medium of claim 9, wherein if for all  
2 possible parametric inputs the non-parametric input and output are not consistent  
3 with a generator output, the trace is not valid.

1            16.    The computer-readable storage medium of claim 9, wherein if the  
2 specification of the generator is sequentially deterministic, and hence does not  
3 depend on parametric inputs, the method further comprises translating the generator  
4 into a checker and using that checker to verify the trace.

1            17.    An apparatus that verifies whether a trace can be produced by a  
2 generator, comprising:

3           a receiving mechanism configured to receive a specification for the generator,  
4   wherein the generator is a finite state machine that defines a set of inputs and outputs,  
5   and wherein the generator may contain parametric inputs to model non-determinism;  
6           wherein the receiving mechanism is additionally configured to receive the  
7   trace, wherein the trace is a sequence of assignments of non-parametric inputs and  
8   outputs for the generator, and wherein the trace does not contain assignments of  
9   parametric inputs;  
10          a data structure building mechanism configured to use the specification to  
11   build a data structure that can be used to determine if a non-parametric input and  
12   output are consistent with a parametric input and output for the generator; and  
13          a verification mechanism configured to verify elements of the trace, wherein  
14   verifying a given element involves using the data structure to determine if there exists  
15   any parametric input assignment that causes a match between non-parametric inputs  
16   and outputs of the generator with the ones specified in the given element of the trace.

1           18.    The apparatus of claim 17,  
2           wherein the generator is sequentially deterministic, which means that there  
3   exists a single next state for each combination of current state, non-parametric input,  
4   and output; and  
5           wherein while using the data structure to determine if there exists any  
6   parametric input assignment, the verification mechanism is configured to,  
7                    use the data structure to perform a satisfiability test to  
8                    determine if there exist any parametric inputs that can match the non-  
9                    parametric input and output assignment of the generator with the ones  
10                   of the trace at a current state, and to

11                   compute a unique next state based on the current state, the  
12                   non-parametric input and the output.

1           19.    The apparatus of claim 17,  
2           wherein the generator is sequentially non-deterministic, which means that the  
3           next state can depend on a parametric input, and consequently there can exist more  
4           than one next state for some combinations of current state, non-parametric input, and  
5           output; and

6           wherein while using the data structure to determine if there exists any  
7           parametric input assignment, the verification mechanism is configured to determine a  
8           set of next states of a generator;

9           wherein determining the set of next states involves considering all possible  
10          parametric inputs, all states in a current set of states, the non-parametric input and the  
11          output;

12          wherein if there exists at least one state in the set of next states, the non-  
13          parametric input and output are consistent with the generator.

1           20.    The apparatus of claim 19, wherein while determining the set of next  
2           states the verification mechanism is configured to compute a forward image and  
3           constraining the parametric input and output to their assignments in the trace.

1           21.    The apparatus of claim 17, wherein the trace is produced by a  
2           simulation of a system under test.

1           22.    The apparatus of claim 17, wherein the data structure is in the form of  
2           a binary decision diagram (BDD).

1           23.     The apparatus of claim 17, wherein if for all possible parametric  
2 inputs the non-parametric input and output are not consistent with a generator output,  
3 the trace is not valid.

1           24.     The apparatus of claim 17, wherein if the specification of the  
2 generator is sequentially deterministic, and hence does not depend on parametric  
3 inputs, the verification mechanism is configured to translate the generator into a  
4 checker and use that checker to verify the trace.

1           25.     A means for verifying whether a trace can be produced by a generator,  
2 comprising:

3           a receiving means for receiving a specification for the generator, wherein the  
4 generator is a finite state machine that defines a set of inputs and outputs, and  
5 wherein the generator may contain parametric inputs to model non-determinism;

6           wherein the receiving means is additionally configured to receive the trace,  
7 wherein the trace is a sequence of assignments of non-parametric inputs and outputs  
8 for the generator, and wherein the trace does not contain assignments of parametric  
9 inputs;

10          a data structure building means configured to use the specification to build a  
11 data structure that can be used to determine if a non-parametric input and output are  
12 consistent with a parametric input and output for the generator; and

13          a verification means configured to verify elements of the trace, wherein  
14 verifying a given element involves using the data structure to determine if there exists  
15 any parametric input assignment that causes a match between non-parametric inputs  
16 and outputs of the generator with the ones specified in the given element of the trace.